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ABSTRACT

An account of the relationship of reading to language that depends on a distinction between primary linguistic activity itself--the processes of producing, perceiving, understanding, rehearsing, or recalling speech--and the speaker-hearer's awareness of this activity was proposed at a conference sponsored by the National Institute of Child Health and Human Development and entitled "Communicating by Language--The Relationships Between Speech and Learning to Read." Participants also considered what, besides competence in his native language, is necessary before the child can learn to read. If language is acquired through maturation rather than deliberately and consciously learned, linguistic awareness is not necessary. But reading is a secondary language-based skill, not a primary linguistic activity, and so requires a degree of linguistic awareness, particularly (for English) of morphophonemic segments. (TO)

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The Relationships Between Speech and Reading

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For scientists who have a special concern with language—researchers in linguistics, phonetics, speech science, experimental psychology, and communications engineering—no subject in the school curriculum arouses as much interest as reading. It is impossible to speculate very deeply about reading without touching on the nature of thought and language, and on the fundamental role that reading plays in this society. At first, of course, because his own experience of learning to read is so far in the past, the speculator takes his literacy for granted, just as he does his ability to speak and to listen to language. It is regrettable that some have speculated no further and rashly issued *ex cathedra* directives about the proper methods of reading instruction. Those who do consider a little further realize that reading is really a rather remarkable activity which could hardly have been predicted from what is presently known about the production and perception of speech and language.

Recent research by linguists in generative grammar and by experimental phoneticians in speech perception has, if anything, made reading seem even more remarkable. The form of natural language, as well as its acquisition and function, Chomsky (1965) tells us, are biologically determined. There is good reason to believe, according to Liberman et

al. (1967), that linguistic communication depends on some very special neural machinery, intricately linked in all normal human beings to the vocal tract and the ear. It is therefore rather surprising to find that a substantial number of people can also, somehow, perform linguistic functions with their hands and their eyes. Reading seems more remarkable still when one considers that only in modern Western culture is it a basic social skill. Some civilizations have attained a high level of culture without being literate at all; in many others, reading and writing were the prerogatives of the hierarchy or the skills of the specialist. But this society insists that *everyone* learn to read and, if he wishes to obtain or retain middleclass credentials, to read in silence, rapidly and efficiently. In Augustine's (397 A.D.) *Confessions* (Book VI), he records his amazement on finding that when his teacher, Ambrose, was reading, "his eye glided over the pages, and his heart searched out the sense, but his voice and tongue were at rest . . . the preserving of his voice (which a very little speaking would weaken) might be the . . . reason for his reading to himself." How surprised Augustine would be if he could see millions of children learning to do Ambrose's little trick.

Just about a year ago, a group, including researchers in all the disciplines mentioned earlier, met under NICHD sponsorship at Belmont, the Smithsonian Institution Conference Center in Maryland, for three days of papers and discussion on the relationships between speech and reading.[1] For the most part, they were people who had specialized not in the study of reading but in areas related to it in interesting ways: speech production and perception, phonology, information processing, language acquisition, memory. But the group also included a few people who had carried on research in reading for many years.

The original purpose of the conference was to consider speech and reading from the psychological and linguistic points of view, but the cultural role of reading came in for some heated discussion as well. In retrospect, it seems that there was one question which recurred throughout the conference. The question arose in various guises which may seem quite dissimilar at first. Its most familiar guise is the question of reading readiness: just what, besides competence in his native language, is necessary before the child can learn to read? Another version is, can reading and listening, as Bloomfield (1942) and Fries (1962) thought, be regarded simply as parallel processes in different modalities, converging at some point on a common linguistic path? Or, finally, one can put the question very abstractly: is it really possible to represent the relationships between speech and reading in the form of a nontrivial block diagram?

To answer these questions, or at least to understand them better, it seemed worthwhile to consider a number of differences between speech perception and reading that are interesting because they cannot be attributed merely to differences in modality.[2] To begin

[1] The conference was entitled "Communicating by Language—The Relationships Between Speech and Learning to Read." Those who attended or contributed to the conference included, in addition to the present authors, William F. Brewer, John B. Carroll, Carol Conrad, R. Conrad, Franklin S. Cooper, Robert Crowder, Eleanor J. Gibson, Philip B. Gough, Morris Halle, James J. Jenkins (co-chairman), Edward S. Klima, Paul A. Kolers, David LaBerge, Joe L. Lewis, Alvin M. Liberman (co-chairman), Isabelle Y. Liberman, Lyle L. Lloyd, John Lotz, Samuel E. Martin, George A. Miller, Donald A. Norman, Wayne O'Neil, Monte Penney, Michael I. Posner, Merrill S. Read, Harris B. Savin, Donald Shankweiler, and Kenneth N. Stevens. The conference proceedings are published as *Language by Ear and by Eye* (Kavanagh and Mattingly, 1972).

[2] These differences were pointed out by Liberman at an earlier NICHD conference (Kavanagh, 1968).

with, listening is easy and reading is hard. All living languages are spoken languages, and every normal child acquires through maturation a tacit knowledge of the grammatical rules of his native tongue and can speak and understand it. In fact, we are forced to conclude that the child has in some sense an innate ability to perceive speech, for without some such ability he could not collect the linguistic data that Chomsky (1965) asserts are required to infer these grammatical rules. Indeed, some recent work by Eimas et al. (1971) suggests that a four-week-old infant is capable of phonetic discrimination. On the other hand, relatively few languages in the history of the world have been written languages, and the alphabet seems to have been invented only once. In general, children must be deliberately taught to read, and despite this teaching, many of them fail to learn. Someone who has been unable to acquire language by listening—for example, a congenitally and profoundly deaf child—will hardly be able to acquire it by reading; on the contrary, a child with a language deficit owing to deafness will have great difficulty learning to read properly.

Secondly, the form in which information is presented is basically different for the listener and the reader. The listener is processing a complex acoustic signal in which the speech cues lie buried. (A "speech cue" is a specific acoustic event that carries linguistic information; for example, the aspiration that distinguishes voiceless /p, t, k/ from voiced /b, d, g/.) The cues are not discrete events, well separated in time and frequency; they blend into one another in complex ways. The segmental sounds the listener perceives quite often have no obvious segmental counterparts in the signal. To recover the phonetic segments, the listener has first to separate the speech cues from a mass of irrelevant detail. The process is largely unconscious; and in many

cases a listener is quite unable to hear a speech cue as a purely acoustic event; he hears only phonetically (Mattingly et al., 1971). The complexity of the listener's task is indicated by the fact that no scheme for speech recognition by machine has yet been devised that can perform it properly. The reader, on the other hand, is processing a series of symbols which are quite simply related to the physical medium which conveys them. The marks in black ink are information; the white paper is background. The reader has no difficulty in seeing the letters as visual shapes if he chooses to, and optical character recognition by machine, though it is a very challenging problem for the engineer, is one that can be solved.

If reading and listening differed only in modality, one would expect that a visual presentation of speech that preserved the essential linguistic information could be easily read and, conversely, that an acoustic representation of written text which clearly differentiates the sounds representing the letters would be easy to listen to. But neither prediction is correct. It is possible to display speech visually in the form of a sound spectrogram, which shows the distribution of energy in the acoustic frequency range over time. We know that a spectrogram contains most of the essential linguistic information, for it can be converted back to acoustic form without much loss of intelligibility (Cooper, 1950). Yet reading a spectrogram is very slow work at best, and at worst, impossible. The converse task, "reading" written characters represented in acoustic form, is somewhat easier but not very fast. For example, Morse Code, or the various acoustic alphabets for the blind reader, can be understood only at rates much slower than a typical listening rate for speech.

Finally, the number of different sounds used in speech in all the

languages of the world is relatively small. These sounds can be classified in terms of their component phonetic features—voiced or voiceless, stop or fricative, labial or dental or velar—and the number of these features is *very* small—fifteen or twenty at most (Stevens and Halle, 1967). But the situation with the writing systems of the world, as one can verify by spending an hour or two looking at the plates in David Diringer's book, *The Alphabet* (1968), is very different. Formally speaking, the symbols used in writing systems have an endless variety, and so do conventions for arrangement of symbols on the page. Swift (1727) does not exaggerate in his description of the writing system of the Lilliputians in *Gulliver's Travels:* "Their manner of writing is very peculiar, being neither from the left to the right, like the Europeans; nor from the right to the left, like the Arabians; nor from up to down, like the Chinese; nor from down to up like the Cascagians, but aslant from one corner of the paper to the other, like ladies in England." (Book I, Chap. 6)

However, if one looks at a writing system not just as an ensemble of visible marks but as a representation of some linguistic level, one finds a more orderly variation. The possible levels seem to range from

the morphemic to the phonetic. Chinese characters are essentially morphemic; no information about pronunciation is given. If one wishes to read aloud in some dialect of Chinese one must have memorized the phonetic values of the characters in that dialect. The English writing system, as Chomsky (1970) has remarked, is essentially morphophonemic. Thus we use the letter *s* for the regular plural morpheme even though it is phonetically realized not only as [s] in *cats* but also as [z] in *cans* and as [əz] in *cases*. The orthography preserves the morphological relationship between *sign* and *signature* even though the phonetic vowel written as *i* is different in the two words and the *g* is pronounced in *signature* but silent in *sign*. But, as Martin points out in his conference paper, English, unlike Chinese, does not always define the morpheme boundaries clearly. Are *misled, molester,* and *bedraggled* to be read as *mis+led, molest+er, and be+draggled* or as *misl+ed, mole+ster*, and *bed+raggled*? Still other writing systems are fairly close to the phonetic level, for instance those used for Finnish or Spanish. Either their morphology is less complex than that of English, or some of the morphological complexity is masked by the written language for the sake of phonetic regularity. In his conference paper, Klima explores this range of orthographic variation from a theoretical standpoint, proposing several conceivable orthographic conventions for representing morphological and phonological content of sentences.

Twenty years ago, it could have been said that the range of writing systems spread over most of the known linguistic domain and that in principle there was no interesting restriction on the linguistic levels they represented, but the findings of the generative grammarians and the experimental phoneticians compel a drastic revision of this view. It is now clear that there are extensive areas in semantics, syntax, and speech

perception which are part of the speaker's competence in his native language. Yet, except for the purpose of examples in the literature of linguistics and phonetics, one does not encounter writing consisting of deep structure tree diagrams and transformations, or, on the other hand, writing consisting of articulatory patterns, narrow phonetic transcriptions, distinctive features, or spectrographic patterns.[3] Thus, it now appears possible to make a significant generalization about writing systems. They actually represent, as Cooper pointed out at the conference, a relatively narrow linguistic stratum. Moreover, this stratum does not include the level at which the listener perceives speech. In short, writing tends to represent language at the morphemic, morphophonemic, or broad phonetic level, while speech represents language at the acoustic level.

The differences which have been listed indicate that even though reading and listening are both clearly linguistic and have an obvious similarity of function, they are not really parallel processes. Instead, a rather different account of the relationship of reading to language is proposed. This account depends on a distinction between primary linguistic activity itself and the speaker-hearer's awareness of this activity. Primary linguistic activity consists of the processes of producing, perceiving, understanding, rehearsing, or recalling speech. Many investigators have come to think that these

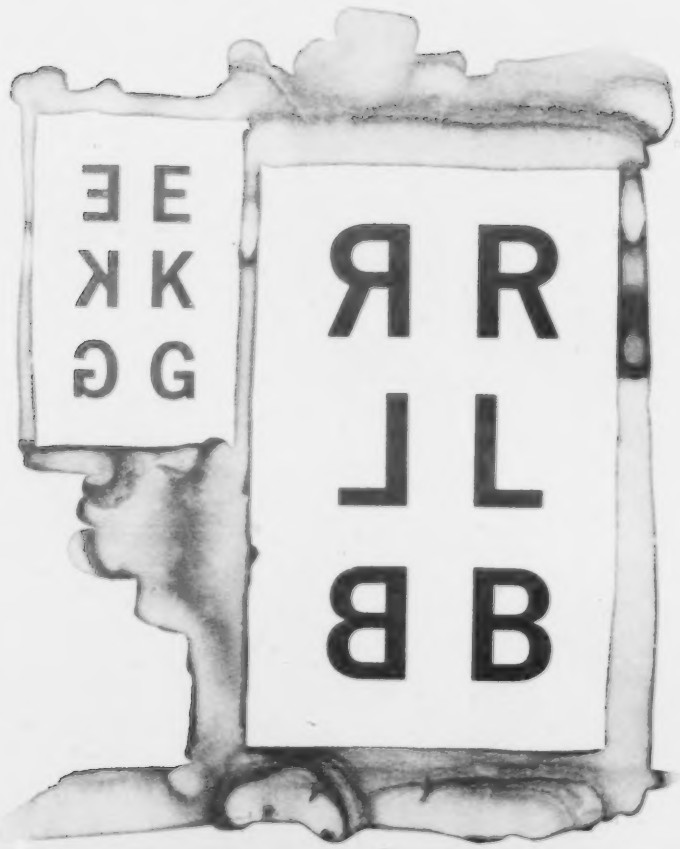
[3] There have been a few interesting exceptions to this generalization. The Hankul alphabet of the Koreans (described by Martin in his paper for the conference) and the experimental writing systems of Wilkins (1668) and A. G. Bell (1867) described by Dudley and Tarnoczy (1950) represent each speech sound by a symbol depicting articulation, and Potter, Kopp, and Green (1947) used a moving spectrographic display in a project to teach the deaf to read speech sounds.

processes are essentially similar, since they all require the construction or reconstruction of utterances in both phonetic and semantic form (Neisser, 1967). As a cover term for all these processes, the term *synthesis* may be used.

Having synthesized some utterance, the speaker-hearer is conscious not only of a semantic experience (understanding the utterance) and perhaps an acoustic experience (hearing the speaker's voice) but also of experience with certain intermediate linguistic processes. Not only has he synthesized a particular utterance, but he is also aware of having done

so and can reflect upon this experience as he can upon his experiences with the external world.

If language were deliberately and consciously learned, this linguistic awareness would hardly be surprising. One would suppose that development of such awareness is needed to learn language, but language seems to be acquired through maturation. Linguistic awareness seems quite remarkable when one considers how little introspective awareness we have of the intermediate stages of other forms of complex behavior, for example, walking or seeing. The speaker-hearer's linguistic awareness is what gives linguistics its



special advantage over other forms of psychological investigation. Taking his informant's awareness of particular utterances, not at face value but as a point of departure, the linguist constructs a description of the informant's intuitive competence in his language which would be unattainable by purely behavioristic methods.

However, linguistic awareness is far from being evenly distributed over all phases of linguistic activity. As Klima points out in his conference paper, some stages of linguistic activity are more "accessible" than others. Much of the process of synthesis takes place well beyond the range of immediate awareness (Chomsky, 1965) and must be determined inferentially. The speaker-hearer is unaware of the deep structure of utterances or of the processes of speech perception. He is aware of phonetic events and easily detects deviations, and this awareness can be increased with proper phonetic training. At the morphophonemic level, reference to various structural units is possible. Words are perhaps most obvious to the speaker-hearer, and morphemes hardly less so, at least in highly inflected languages. Syllables, depending on their structural role in the language, may be more obvious than morphophonemic segments. In the absence of appropriate psycholinguistic data, any ordering of this sort must be very tentative, and in any case it would be a mistake to overstate the clarity of the speaker-hearer's awareness and the consistency with which it corresponds to a particular linguistic level. But it seems safe to say that, by virtue of this awareness, he has an internal image of the utterance, and this image probably owes more to the morphophonemic representation than to any other level.

Linguistic awareness can become the basis of various language-based skills. Secret languages, such as Pig Latin (Halle, 1964)

form one class of examples. In such languages a further constraint, in the form of a rule relating to the morphophonemic representation, is artifically imposed upon production and perception. If one has synthesized a sentence, an additional mental operation is required to perform the encipherment; and to carry out the process at a normal speaking rate, one has not only to know the encipherment rule but to have developed a certain facility in applying it. A second class of examples are the various systems of versification. The versifier is skilled in synthesizing sentences which conform not only to the rules of the language but also to

an additional set of rules relating to certain phonetic features (Halle, 1970). To listen to verse, one needs at least a passive form of this skill to distinguish correct from incorrect lines without scanning them syllable by syllable. Like Pig Latin, versification requires awareness of the phonetics and phonology of the language.

It would appear that there are clear differences between language-based skills, such as Pig Latin and versification, and primary linguistic activity. For one thing, there seems to be considerable individual variation in linguistic awareness: some speakers are very conscious of linguistic patterns and exploit their awareness with obvious pleasure in verbal play (punning and charades) and verbal work (linguistic and phonetic research). Others seem never to be aware of much more than words and are surprised when quite obvious linguistic patterns are pointed out to them. This variation contrasts markedly with the relative uniformity among different individuals in the primary linguistic activity. Moreover, if one were unfamiliar with Pig Latin or with a system of versification, one might fail to understand what the Pig Latinist or the versifier was up to, but one would not suppose either of them to be speaking an unfamiliar language. And even after one catches on to the trick, the sensation of engaging in something beyond primary lingusitic activity does not disappear; one continues to feel a special demand upon one's linguistic awareness. In short, synthesis of an utterance in primary linguistic activity is one thing; the awareness of this process of synthesis is quite another.

The conclusion suggested here is that reading is not a primary linguistic activity but a secondary language-based skill, and so requires a degree of linguistic awareness.The form in which a written sentence presents itself to the reader is determined not by the actual linguistic information to be

conveyed by the sentence but by the writer's linguistic awareness of the process of synthesizing the sentence, an awareness which he wishes to impart to the reader. Since the reader has much the same linguistic awareness as the writer, and is familiar with the conventions of the writing system, he can synthesize something approximating what the writer intended, and so understand the sentence.

Since the writing system of English is, as has been said, essentially morphophonemic, the reader probably forms something like a morphophonemic representation as he reads. Does he also form a phonetic representation? Though it might seem needless to do so in silent reading, there is reason to think he does. In view of the complex interaction that must take place in primary linguistic processing, it seems unlikely that the reader could omit this step at will. Many information-processing experiments suggest that words and sentences are stored in phonetic form in short-term memory during the mysterious process by which the understanding of utterances takes place. Moreover, even though the writing system may be essentially morphophonemic, linguistic awareness is in part phonetic. Thus a sentence which is phonetically bizarre—"The rain in Spain falls mainly in the plain," for example—will be spotted by the reader. Again, many of those who manage to read and write ordinary text without "inner speech" or any signs of vocalization have to mumble their way through numerical computations, though the numerals, unlike alphabetic words, have no overt phonetic structure. Finally, Erickson et al. (in press) have shown that in a test of recall from short-term memory, Japanese subjects confuse kanji characters that are homophones, even though the kanji, like num-

erals, have no overt phonetic structure.

In conclusion, the question raised earlier in this pamphlet can be reconsidered. What is required for reading readiness? Apparently some degree of linguistic awareness, in particular (for English, at least) awareness of morphophonemic segments. Two of the conference papers directly support this view. Shankweiler and I. Y. Liberman found that a group of poor readers could often identify the first segment of a word like /baeg/ but usually failed to segment the entire word correctly. Savin reported that his subjects, poor readers in Philadelphia schools, could not master Pig Latin and shied away from any word game involving segmentation, but they were happy enough in games where syllable recognition was a sufficient skill. One begins to understand why the alphabet was invented only once.

Are reading and listening parallel processes? Evidently not. Reading appears rather to be parasitical on spoken language, exploiting the reader's awareness of the contents of short-term memory. And finally, can the processes of reading and speech be represented on a single block diagram? Not very easily, because one of the boxes in a block diagram of reading must itself include the kind of partial knowledge of the block diagram of listening and speaking that has here been called linguistic awareness.

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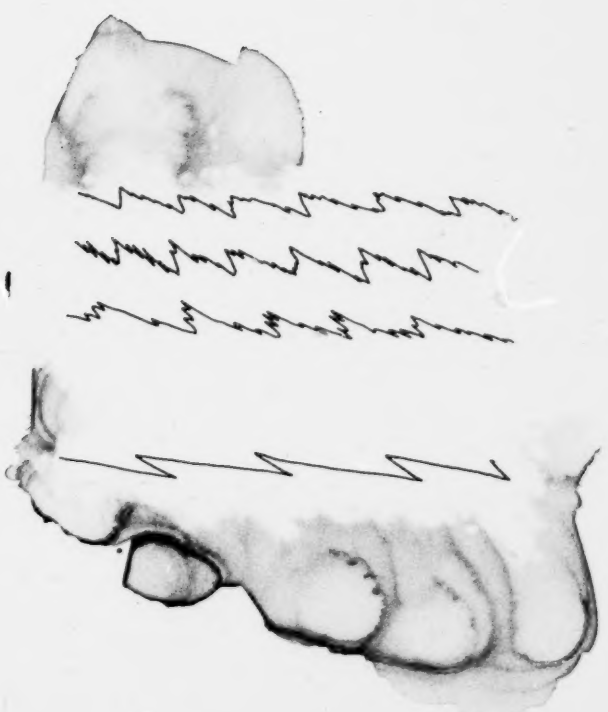

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